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ratio to the study of ranges and pencils in perspective, and of projective and superposed ranges and pencils; the harmonic properties of the complete quadrangle and quadrilateral; properties of involution ranges and pencils, particularly those properties of involution which are used in subsequent chapters on the conic.

In order that the matter may be more readily grasped by the student, the relations of projective forms, anharmonic properties, pole and polar, Carnot's, Pascal's and Desargues's theorems, to the circle are studied before these relations are taken up for the general conic. In the chapters on the conic some of the theorems already proved for the circle are simply restated, others are proved by methods similar to those used for circles, while in several cases alternative proofs —such as proofs by projection—are given. These chapters also contain the classification of conics and discussions of center, foci, diameters and asymptotes. The remaining eight chapters of the book deal for the most part with applications of anharmonic and harmonic ratios, involution, pole and polar, Carnot's, Pascal's and Desargues's theorems to further deductions of properties of triangles, of quadrangles and quadrilaterals, and of conics. The large number of applications and problems contained in these chapters cannot fail to interest the student of mathematics.

The addendum contains fifteen theorems and their proofs on non-projective properties of the straight line and circle. There are two very complete indexes, one of terms and definitions and the other of theorems.

The typographical errors are few and of such obvious nature as to cause the student no difficulty. The type is large and distinct and the figures have been carefully constructed.

It is the opinion of the reviewer that this book is better adapted for use as a text in a first course on projective geometry than any other book in the English language. It may also be used for reference in a lecture course on the subject. The book should do much to revive interest in the study of projective geometry in the undergraduate curriculum and "to encourage the student not to neglect the methods of pure geometry."

C. E. STROMQUIST.

PROBLEMS AND SOLUTIONS.

B. F. FINKEL, CHAIRMAN OF THE COMMITTEE.

PROBLEMS FOR SOLUTION.

Special Notice.—Please reread the requests as to form of solutions on pp. 258–259 of the October 1913 issue. Unless these directions are observed by contributors, solutions must either be entirely rewritten by the committee or else rejected. Put all drawings on separate sheets.

MANAGING EDITOR.

ALGEBRA.

When this issue was made up, solutions had been received for 401, 402, 403, 404, 405, and 407. A solution of 406 is desired.

408. Proposed by EMMA M. GIBSON, Drury College.

Show that if n is a positive integer, the sum of the series

$$1-\frac{2n-1}{1!}+\frac{(2n-1)(2n-2)}{2!}-\cdots+(-1)^{n-1}\frac{(2n-1)(2n-2)\cdots(n+1)}{(n-1)!}$$

is

$$\frac{(-1)^{n-1}(2n-2)(2n-3)\cdots(n+1)n}{(n-1)!}.$$

[From C. Smith's *Treatise on Algebra.*]

409. Proposed by C. E. GITHENS, Wheeling, W. Va.

Find integral values for the edges of a rectangular parallelopiped so that its diagonal shall be rational.

410. Proposed by C. N. SCHMALL, New York City.

Solve the simultaneous equations,

$$x^2+xy+y^2=a,$$

$$x^4+x^2y^2+y^4=b.$$

411. Proposed by V. M. SPUNAR, Chicago, Illinois.

Determine $x_1, x_2, x_3, \cdots x_p$, from the equations

$$\begin{gathered}x_1+x_2+x_3+\cdots+x_p=a_0\\ b_1x_1+b_2x_2+b_3x_3+\cdots+b_px_p=a_1\\ b_1^2x_1+b_2^2x_2+b_3^2x_3+\cdots+b_p^2x_p=a_2\\ \cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\\ \cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\\ \cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\quad\cdot\\ b_1^{p-1}x_1+b_2^{p-1}x_2+b_3^{p-1}x_3+\cdots+b_p^{p-1}x_p=a_{p-1}.\end{gathered}$$

412. Proposed by H. L. SLOBIN, University of Minnesota.

Form the algebraic equation whose roots are: $a_1=\cos\frac{\pi}{9}$, $a_2=-\cos\frac{2\pi}{9}$, $a_3=-\cos\frac{4\pi}{9}$. (See article in this issue, page 113.)

GEOMETRY.

When this issue was made up, solutions had been received for 431, 434 and 435. Solutions of 430, 432 and 436 are desired.

Those interested in 427 may add to the footnote attached thereto in the January issue the following reference: *Das Problem der Kreisteilung*, von A. Mitzscherling, Leipzig and Berlin, 1913.

437. Proposed by J. BROOKS SMITH, Hampden-Sidney, Va.

Let D, E, F be three arbitrary points taken on the sides of a triangle ABC. If Δ and Δ' be the areas of the triangles ABC and DEF, show that

$$\frac{\Delta'}{\Delta}=\frac{AF\cdot BD\cdot CE+AE\cdot CD\cdot BF}{abc},$$

the sign of each factor being determined as follows: Each segment adjacent to one of the vertices of the triangle ABC is to be regarded as positive or negative according as it is drawn towards or from the other vertex on the side containing the segment.

438. Proposed by CLIFFORD N. MILLS, Brookings, South Dakota.

By means of the theorem that the product of the diagonals of a quadrilateral inscribed in a circle is equal to the sum of the two products of pairs of opposite sides, obtain the usual formulæ for $\sin(\alpha\pm\beta)$ and $\cos(\alpha\pm\beta)$ in terms of $\sin\alpha$, $\sin\beta$, $\cos\alpha$, $\cos\beta$ (Godfrey and Siddon's *Geometry*, page 82).